KOKAI PATENT APPLICATION NO. SHO 49-51857

SAW-TOOTH WAVE MULTIPLICATION DEVICE

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SAW-TOOTH WAVE MULTIPLICATION DEVICE

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Attachment: 1 copy each of
Power of attorney
Specification
Drawing
Copy of application

[*There are no amendments to this patent.*]

Specification

1. Title of the invention

Saw-tooth-wave multiplication device

2. Claim of the invention

A saw-tooth wave multiplication device equipped with a delay circuit supplied with an input saw-tooth wave signal and a means for mixing the aforementioned input saw-tooth wave signal with the output signal of the aforementioned delay circuit in equal proportions.

3. Detailed description of the invention

The present invention pertains to a saw-tooth wave multiplication device capable of multiplying saw-tooth wave signal frequency using a simplified structure.

In the past, the method described below has been used to multiply the frequency of a saw-tooth wave signal. Thus, a multivibrator that oscillates at two times the signal frequency of input saw-tooth wave signal is driven by the input saw-tooth wave signal, and the aforementioned vibrator output signal is integrated to form a saw-tooth wave signal of twice the frequency of the

input signal. In other words, in the above-mentioned multiplication device, it is necessary for the input saw-tooth wave signal to synchronize oscillation of the multivibrator, and when fluctuations, etc. occur in the input saw-tooth wave signal, loss of synchronization occurs in the multivibrator and smooth frequency multiplication operation is not possible. Furthermore, when the frequency of the input saw-tooth wave signal is changed, it is necessary to change the oscillation frequency of the multivibrator accordingly, and it is necessary to change the integration constant of the integration circuit that converts the square wave from the vibrator to the saw-tooth wave as well. Therefore, the structure becomes complicated and operational stability is poor; furthermore, conversion of the input signal frequency cannot be done easily.

The purpose of the present invention is to improve the above-mentioned situation and to produce a saw-tooth wave multiplication device with high operating stability and that is capable of easily accommodating a change in frequency of the input saw-tooth wave signal, and the feature of the present invention is to produce a saw-tooth wave multiplication device equipped with a delay circuit supplied with an input saw-tooth wave signal and a means of mixing the aforementioned input saw-tooth wave signal with the output signal of the aforementioned delay circuit in equal proportions.

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A working example of the present invention is explained in further detail with the drawings below. Fig. 1 shows the structure of the device; the input signal to be frequency multiplied is connected to input terminal 11. The saw-tooth wave signal from the above-mentioned input terminal 11 passes to the output terminal through delay circuit 12 and a branch feeds amplifier 14 and the output signal from the aforementioned delay circuit 12 and the output signal of the aforementioned amplifier 14 are mixed in equal proportions and the mixed output signal is obtained from output terminal 13. In this case, the above-mentioned delay circuit 12 has a structure comprising a charge coupled device (CCD), for example, and the delay time is set by

the oscillation frequency of oscillator 15.

When mixing of signals from delay circuit 12 and amplifier 14 based on a sine wave are considered, and assuming that the delay time of the delay circuit 12 is T, the direct signal from amplifier 14 (shown by the solid line in the fig.) and delayed signal by time T from delay circuit 12 (shown by the dotted line in the fig.) become opposite in phase when the input signal is 1/2T=fo, or 3fo, etc., and mutual cancellation occurs. Furthermore, when the input signal is 2fo, 4fo, etc., the two become in-phase and are mutually intensified, and with an increase in frequency, cancellation and reinforcement are repeated.

In other words, the relationship between the input signal frequency and mixed signal level of delay signal and direct signal is shown by the characteristic chart in Fig. 3, and odd number frequency waves are mutually cancelled and even number frequency waves are ideally increased by approximately 6 dB.

Assuming that the saw-tooth wave signal such as the one shown in Fig. 4(A) is formed on input terminal 11, the spectra of the aforementioned saw-tooth wave signal becomes the spectra shown in Fig. 4(B). In this case, when the frequency of the above-mentioned saw-tooth wave signal is equal to fo shown in Fig. 2, the spectra shown in Fig. 4(C) alone remains when the output signals of delay circuit 12 and amplifier 14 are mixed. In other words, fo, 3fo, 5fo, etc. of Fig. 4(B) are cancelled, and 2fo=fo', 4fo=2fo'... alone remain. Thus, the spectra shown in Fig. 4(C) is a spectra with a frequency two times the saw-tooth wave signal of the saw-tooth wave shown in Fig. 4(A), and a saw-tooth wave signal multiplied as shown in Fig. 4(D) is obtained from output terminal 13.

Thus, in the above-mentioned multiplication device, the delay time T of delay circuit 12 is selected according to the frequency of the input saw-tooth wave signal, and multiplication of a given saw-tooth wave signal is made possible through control of the oscillation frequency of oscillator 15.

In the above working example, a charge coupling device (CCD) was used as delay circuit 12, but the circuit is not especially limited and, for example, delay time variable plasma coupled type semiconductor device may be used as well.

As explained above, according to the present invention, production of a saw-tooth wave multiplication device with stabilized operation can be achieved using a simple delay circuit, and a change in the input signal frequency can be easily accommodated by setting the delay time of the delay circuit to the saw-tooth wave frequency.

4. Brief description of figures

Fig. 1 is a structural drawing of the saw-tooth wave multiplication device of concern in the working example of the present invention, Fig. 2 is an example of the signal waveform mixing and is used for explanation of the above-mentioned device, Fig. 3 is the characteristic chart used for explanation of the mixed output signal, and Fig. 4(A) to (D) are explanatory drawings of the change in spectra of the input saw-tooth wave signal and output saw-tooth wave signal.

Explanation of codes

11: Input terminal

12: Delay circuit

13: Output terminal

15: Oscillator

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Fig. 1

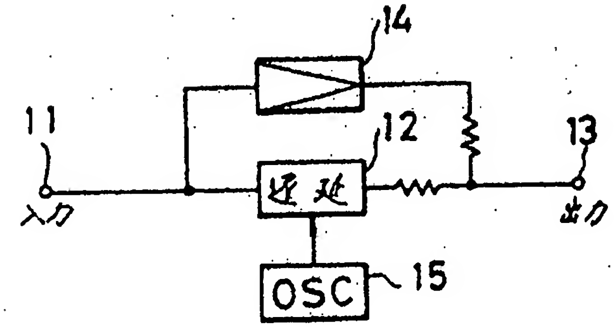

14
11
12
13
遅延
入力
出力
OSC
15

Fig. 2

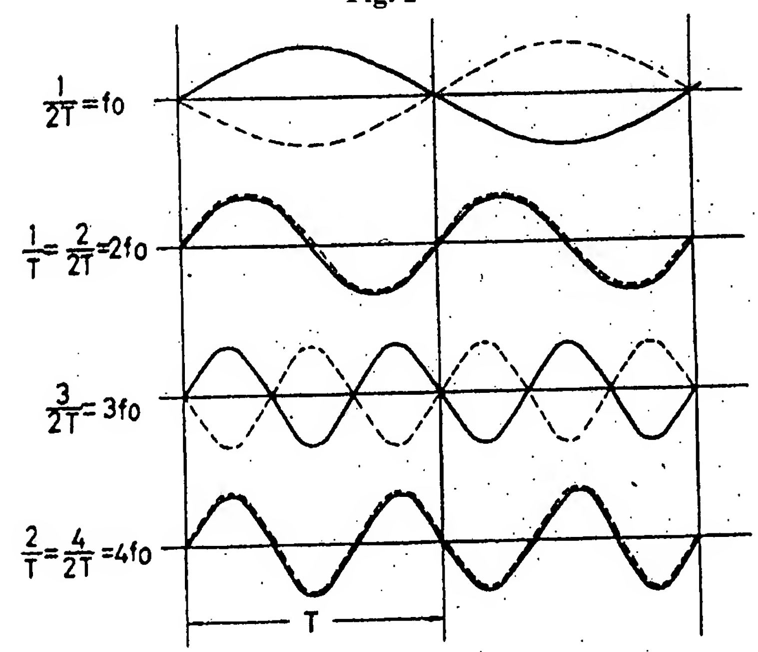

$\frac{1}{2T}=f_0$
$\frac{1}{T}=\frac{2}{2T}=2f_0$
$\frac{3}{2T}=3f_0$
$\frac{2}{T}=\frac{4}{2T}=4f_0$
T

Fig. 3

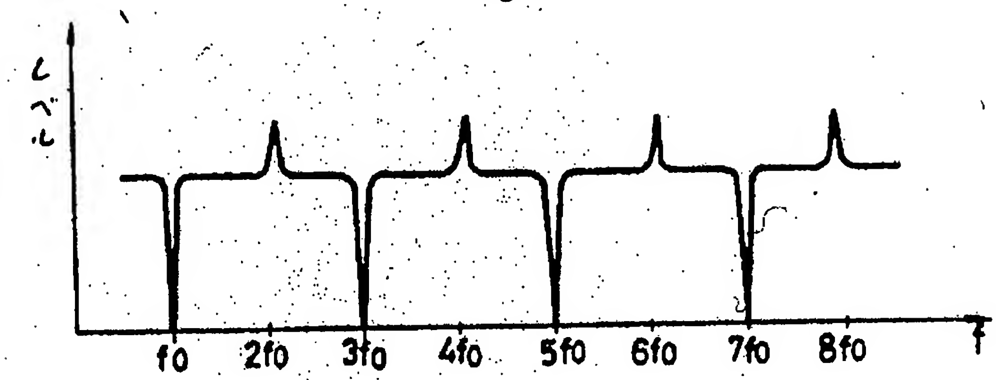
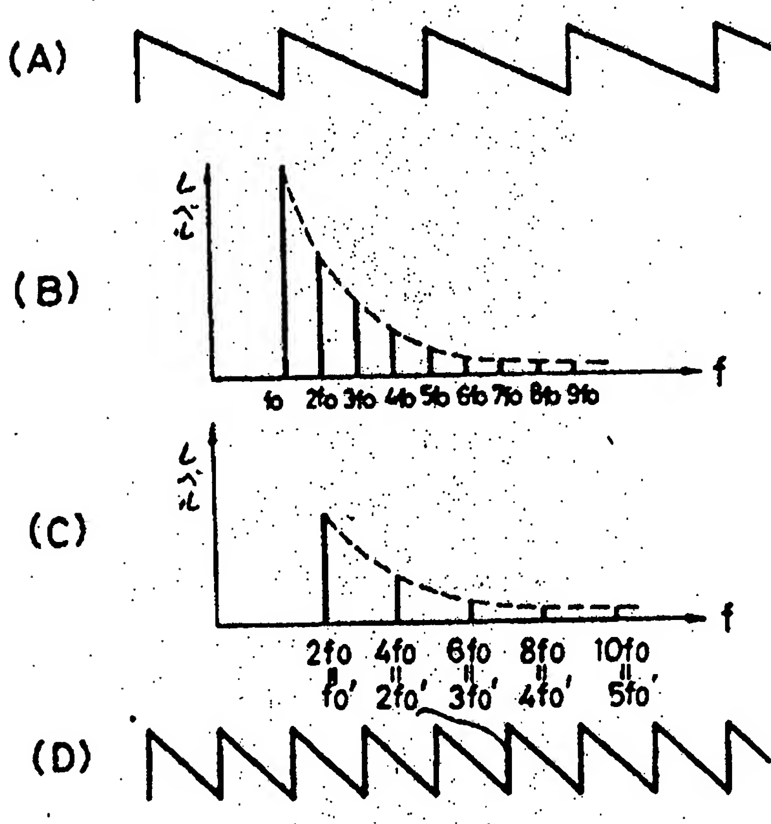


Fig. 4



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